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Abstract

A total of 216 pigs (initially 11.7 lb and 21 d of age) was used in a 35-<1 growth trial to determine the effect of dietary L-carnitine on growth performance and tissue accretion rates for the early-weaned pig when fed a porcine plasma-based diet. Pigs were blocked by>weight, ancestry, and sex in a randomized complete block design, resulting in six pigs per pen (three barrows and three gilts) and six pens per treatment. Experimental diets were fed in two phases from d 0 to 35 postweaning. During Phase I (d 0 to 14 postweaning), the control diet was corn-soybean meal based; included 7.5% spray-dried porcine plasma, 25% dried whey, and 1.75% spray-dried blood meal; and was formulated to contain 1.6% lysine; and .44% methionine. On d 14, all pigs were switched to a Phase II (d 14 to 35 postweaning) diet that contained 10% dried whey and 2.5% spray-dried blood meal and was formulated to contain 1.25% lysine and .36% methionine. L-carnitine replaced corn in the Phase I and II control diets to provide dietary L-carnitine levels of 250, 500, 750, 1,000, and 1,250 ppm. On d 35, three barrows and three gilts per treatment (one pig per block) were slaughtered to determine carcass composition. From d 0 to 14 postweaning, increasing L-carnitine had no effect on growth performance. From d 14 to 35 and d 0 to 35, no differences occurred in average daily gain (ADG) and average daily feed intake (ADFI); however, pigs fed 1,000 ppm L-carnitine were more efficient (F/G) over the entire trial and were 1.94 lb heavier on d 35 than pigs on the positive control treatment. Plasma carnitine levels taken on day 14 increased as dietary carnitine increased. Percentage carcass CP, lipid, and daily protein accretion were not influenced by dietary L-carnitine on d 35. However, daily fat accretion was reduced, with pigs on the 750 ppm L-carnitine having the lowest daily fat accretion. Based on these results, L-carnitine addition reduces daily fat accretion and improves F/G when fed during the nursery phase.; Swine Day, Manhattan, KS, November 17, 1994

Keywords

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THE EFFECT OF DIETARY L-CARNITINE ON GROWTH PERFORMANCE AND TISSUE ACCRETION RATES IN THE EARLY-WEANED PIG[1]

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Summary

A total of 216 pigs (initially 11.7 lb and 21 d of age) was used in a 35-d growth trial to determine the effect of dietary L-carnitine on growth performance and tissue accretion rates for the early-weaned pig when fed a porcine plasma-based diet. Pigs were blocked by weight, ancestry, and sex in a randomized complete block design, resulting in six pigs per pen (three barrows and three gilts) and six pens per treatment. Experimental diets were fed in two phases from d 0 to 35 postweaning. During Phase I (d 0 to 14 postweaning), the control diet was corn-soybean meal based; included 7.5% spray-dried porcine plasma, 25% dried whey, and 1.75% spray-dried blood meal; and was formulated to contain 1.6% lysine; and .44% methionine. On d 14, all pigs were switched to a Phase II (d 14 to 35 postweaning) diet that contained 10% dried whey and 2.5% spray-dried blood meal and was formulated to contain 1.25% lysine and .36% methionine. L-carnitine replaced corn in the Phase I and II control diets to provide dietary L-carnitine levels of 250, 500, 750, 1,000, and 1,250 ppm. On d 35, three barrows and three gilts per treatment (one pig per block) were slaughtered to determine carcass composition. From d 0 to 14 postweaning, increasing L-carnitine had no effect on growth performance. From d 14 to 35 and d 0 to 35, no differences occurred in average daily gain (ADG) and average daily feed intake (ADFI); however, pigs fed 1,000 ppm L-carnitine were more efficient (F/G) over the entire trial and were 1.94 lb heavier on d 35 than pigs on the positive control treatment. Plasma carnitine levels taken on day 14 increased as dietary carnitine increased. Percentage carcass CP, lipid, and daily protein accretion were not influenced by dietary L-carnitine on d 35. However, daily fat accretion was reduced, with pigs on the 750 ppm L-carnitine having the lowest daily fat accretion. Based on these results, L-carnitine addition reduces daily fat accretion and improves F/G when fed during the nursery phase.

(Key Words: Early-Weaned Pigs, L-Carnitine, Growth, Pigs.)

Introduction

Previous research at Kansas State University has shown that feeding high levels of L-carnitine in the nursery phase (from d 0 to 35 postweaning) had no effect on growth performance. However, pigs receiving high levels of L-carnitine (1,000 ppm) had significantly lower lipid, moisture, and ash accretion rates when compared to pigs offered diets with no added carnitine. This reduction of lipid accretion rates by carnitine supplementation has been observed previously in even earlier work conducted at KSU. This research demonstrated that pigs fed diets containing high levels of dietary L-carnitine during the first 2 weeks postweaning were more efficient during the Phase II period.

[1]Appreciation is expressed to Lonza, Inc., Fairlawn, NJ, for partial financial assistance and for providing the L-carnitine used in this trial.

[2]Lonza, Inc., Fairlawn, NJ.

Additionally, pigs fed dietary L-carnitine had lower lipid accretion rates. However, the exact requirement of L-carnitine needed in this nursery phase has not been determined. Therefore, the objective of this experiment was to determine the appropriate level of L-carnitine needed in nursery diets containing spray-dried blood products to enhance growth performance and tissue accretion rates.

Procedures

A total of 216 (21-d old) pigs was blocked by initial weight, ancestry, and sex and allotted to each of six dietary treatments. There were six pigs per pen (three barrows and three gilts) and six pens per treatment. Phase I consisted of d 0 to 14 postweaning, and Phase II was from d 14 to 35 postweaning. Added L-carnitine levels were fed during the entire nursery phase (d 0 to 35 postweaning). A basal diet was formulated to contain 7.5% spray dried porcine plasma, 1.75% spray-dried blood meal, and 25% dried whey (Table 1). Experimental treatments fed during Phase I were achieved by adding increasing levels of L-carnitine to the basal diet to achieve dietary carnitine levels of 250, 500, 750, 1,000, and 1,250 ppm. The Phase I diet was formulated to contain 1.5% lysine and .42 % dietary methionine. During Phase II (d 14 to 35 postweaning), the basal diet was corn-soybean meal-based and contained 2.5% spray-dried blood meal and 10% dried whey. During Phase II, pigs were fed the same dietary carnitine level as in Phase I. All Phase I diets were fed in a pelleted form. The Phase II diet was fed in a meal form.

Pigs were housed in an environmentally controlled nursery. Temperature was maintained at approximately 90°F for the first week of the trial and lowered by approximately 5°F per week to maintain pig comfort. Pigs were offered ad libitum access to food and water. Pigs were weighed and feed disappearance was determined on d 7, 14, 21, 28, and 35 postweaning to calculate ADG, ADFI,and F/G. Pigs were bled on d 14 to evaluate plasma L-carnitine levels. Four males and four females were slaughtered at the start of the study for determining initial carcass composition. On d 35, six pigs per treatment (three females and three males per treatment) were selected randomly and slaughtered to determine daily accretion rates (protein and lipid) for the 35-d nursery phase.

Results and Discussion

From d 0 to 14 postweaning, increasing L-carnitine had no influence ($P>.10$) on growth performance (Table 2). From d 14 to 35 and d 0 to 35, no differences occurred in ADG and ADFI; however, pigs fed the 1,000 ppm L-carnitine were more efficient ($P=.07$) over the entire trial and were 1.94 lb heavier on d 35 compared with pigs fed the control diet.

Increasing dietary L-carnitine raised the level of carnitine in the plasma. This allows us to conclude that the biological activity of L-carnitine was increased; hence, all effects seen in this experiment were due to increasing levels of dietary L-carnitine.

Percentage carcass CP and daily protein accretion were not influenced by dietary L-carnitine on d 35. Although percentage carcass lipid was not influenced, daily fat accretion was reduced (quadratic, $P=.09$) with increasing dietary L-carnitine, and pigs fed 750 ppm L-carnitine had the lowest fat accretion rates. These results are similar to those previously reported at Kansas State University (1990 and 1993 Swine Day reports).

Based on the results of this experiment, L-carnitine addition reduces daily fat accretion and improves F/G when fed during the nursery phase. However, L-carnitine is not currently available in the U.S. for use in swine diets.

Table 1. Phase I and II Basal Diet Composition, %[a]

Ingredient	Phase I	Phase II
Corn[b]	41.65	58.76
Dried whey	25.00	10.00
Soybean meal, (48% CP)	14.91	21.26
Spray-dried porcine plasma	7.50	
Soybean oil	5.00	3.00
Spray-dried blood meal	1.75	2.50
Monocalcium phosphate (21% P)	1.82	1.97
Antibiotic[c]	1.00	1.00
Limestone	.64	.83
Vitamin premix	.25	.25
Mineral premix	.15	.15
DL-methionine	.15	.05
Copper sulfate	.075	.075
L-lysine	.10	.08
Total	100.00	100.00

[a]Phase I basal diet was formulated to contain 1.5% lysine, .42% methionine, .90% Ca, and .80% P; the Phase II basal diet was formulated to contain 1.25% lysine, .35% methionine, .90% Ca, and .80% P.
[b]L-Carnitine replaced corn on a lb per lb basis to achieve the 250, 500, 750, 1,000, and 1,250 ppm dietary carnitine experimental diets.
[c]Provided 50 g per ton carbodox.

Table 2. Performance of Pigs Fed Increasing Levels of L-Carnitine from d 0 to 35 Postweaning[a]

	Added carnitine, ppm						
Item	0	250	500	750	1,000	1,250	CV
d 0 to 14							
ADG, lb	.76	.75	.76	.77	.81	.80	10.8
ADFI, lb	.87	.89	.90	.88	.90	.91	11.0
F/G	1.15	1.17	1.19	1.16	1.11	1.14	6.1
d 14 to 35							
ADG, lb	1.17	1.19	1.22	1.20	1.23	1.22	7.2
ADFI, lb	2.14	2.11	2.21	2.14	2.12	2.22	6.7
F/G	1.83	1.78	1.81	1.79	1.74	1.83	5.8
d 0 to 35							
ADG, lb	1.00	1.01	1.04	1.03	1.06	1.05	7.4
ADFI, lb	1.63	1.62	1.69	1.64	1.63	1.69	7.0
F/G[e]	1.62	1.60	1.63	1.60	1.55	1.62	4.6
d 35							
PA, g per d[f]	58.0	56.3	55.8	53.1	54.6	56.3	11.8
FA, g per d[bg]	42.9	41.9	41.8	37.0	42.3	45.1	15.2
PC, nmole per mL[h]	13.7	34.9	42.2	50.2	51.6	50.2	14.6
d 35 wt	46.95	47.25	48.09	47.59	48.88	48.59	5.9

[a]Two hundred and sixteen weanling pigs were used (initially 11.7 lb and 21 d of age), 6 pigs per pen with 6 pens per treatment.
[b]Quadratic effect of dietary L-carnitine ($P=.09$).
[c]Linear effect of dietary L-carnitine ($P<.01$).
[d]Quadratic effect of dietary L-carnitine ($P<.01$).
[e]Control vs 1,000 ppm L-carnitine ($P=.07$).
[f]PA = protein accretion rates.
[g]FA = fat accretion rates.
[h]PC = plasma carnitine.